Candidate Name	Centre Number	Candidate Number

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

CHEMISTRY 6031/4

PAPER 4 Practical Test

SPECIMEN PAPER 2 hour 30 minutes

Candidates answer on the question paper.
Additional materials:
As listed in Instructions to Supervisors
Electronic calculator

TIME 2 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces at the top of this page.
Answer **all** questions.
Write your answers in the spaces provided on the question paper.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.
You are advised to show all working in calculations.
Use of a Data Booklet is unnecessary.

Qualitative analysis notes are printed on pages 10 and 11.

FOR EXAMINER'S USE	
1	
2	
3	
TOTAL	

This question paper consists of 11 printed pages and 1 blank page.

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For Examiner's Use

1 You are required to estimate the percentage composition of iron (II) ions in a brown contraceptive pill. The major component of the pill is, ferrous fumarate, $C_4H_2FeO_4$.

FA1 are three reddish brown contraceptive pills.

FA2 is a 0.001 $moldm^{-3}$ $KMnO_{4\,(aq)}$.

(a) Weigh an empty small beaker.

Place **FA1** (the three pills) in the small beaker and weigh again.

Record your weighings in **Table 1.1**.

Table 1.1

mass of small beaker + **FA1**/g	
mass of empty small beaker / g	
mass of **FA1** used /g	

[2]

Crush the three pills using mortar and pestle.

Transfer all the powder into the small beaker.

Using a measuring cylinder add 15 cm^3 of hot 1.0 $moldm^{-3}$sulphuric acid to the crushed pills in the small beaker and stir vigorously with a glass rod.

Transfer all the contents of the beaker into a 250 cm^3 volumetric flask. Make up to the mark with distilled water.

Mix the contents thoroughly by shaking and label this solution **FA3.**

(b) Filter **FA3** into a clean beaker

Pipette 25.00 cm^3 of the filtered **FA3** into a conical flask and add 10.00 cm^3 of 1.0 $moldm^{-3}$sulphuric acid.

Titrate the contents of the conical flask with **FA2.**

Repeat the titration as many times as you think necessary to obtain accurate results.

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1 **(b)** Record your burette readings in **Table 1.2.**

Table 1.2:

final burette reading / cm^3				
initial burette reading/ cm^3				
volume of **FA2** used / cm^3				

[15]

Summary

25.00 cm^3 of **FA3** reacted with _____ cm^3 of **FA2**.

Show which results you used to obtain this volume of **FA2** by placing a tick under the readings in **Table 1.2.**

In acidic conditions, MnO_4^- and Fe^{2+} ions react according to the following half equations:

$$MnO^-_{4(aq)} + 8H^+_{(aq)} + 5e^- \rightleftharpoons Mn^{2+}_{(aq)} + 4H_2O_{(l)}$$

$$Fe^{3+}_{(aq)} + e^- \rightleftharpoons Fe^{2+}_{(aq)}$$

(c) Write a balanced equation for the reaction between Fe^{2+} and MnO_4^-.

[1]

(d) Calculate the number of moles of $MnO^-_{4(aq)}$ in the volume of **FA2** which reacted with 25 cm^3 of **FA3**.

[1]

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1 **(e)** Calculate the number of moles of $Fe^{2+}_{(aq)}$ in 25.00 cm^3 of **FA3.**

[1]

(f) Determine the mass of Fe^{2+} in the brown contraceptive pill.

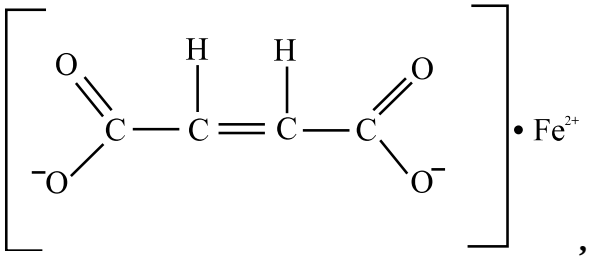
$A_r(Fe) : 55.8$

[2]

(g) Estimate the percentage composition of iron in the brown contraceptive pill.

[1]

(h) Given that the structural formulae of ferrous fumarate is



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Suggest why the value of the percentage composition of iron determined in the experiment is much higher than the actual value.

_____

_____

_____ [1]

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1 **(i)** Describe and explain how the end point is observed in this analysis.

_____

_____

_____ [2]

[Total:20]

For Examiner's Use

ASSESSMENT OF PLANNING SKILLS

DO NOT CARRY OUT YOUR PLAN.

2 Sodium is a very reactive metal which is stored under oil to prevent contact with air and water vapour.

The reaction of sodium with water can be represented by the equation,

$$2\,Na_{(s)} + 2\,H_2O_{(l)} \rightarrow 2\,NaOH_{(aq)} + H_{2(g)}.$$

You are required to determine the A_r of sodium using a given sample of sodium metal basing on the above reaction.

Present your plan as a sequence of numbered steps and draw a diagram showing the set up of the experiment. Your plan should show how you would use your results to determine the A_r of sodium.

Assume you are provided with the following:

a piece of sodium metal
water
thistle funnel
absorbent paper
rubber stopper
delivery tube
measuring cylinder
beaker

[molar gas volume, V_m, = 24 $dm^3\,mol^{-1}$ at r.t.p.]

The plan

[Total :10]

For Examiner's Use

3 **FA1** is a solution containing **one** cation and **two** anions.

You are required to identify the ions in **FA1** by carrying out the tests described in the table.

In all the tests, the reagents should be added gradually until no further change is observed, with shaking after each addition. Take a portion of **FA1** to be about 2 cm^3.

Record your observations and deductions in the spaces provided.

Your answers should include,

(i) details of colour changes and precipitates formed,

(ii) the names of gases evolved and details of the test used to identify each one.

You should indicate clearly at what stage in a test a change occurs writing any deductions you may make alongside the observation on which they are based.

	test	observations [13]	deductions [8]
(a)	Describe the appearance of **FA1.**		
(b)	To a portion of **FA1**, add $NaOH_{(aq)}$ until in excess and then heat		
(c)	To a portion of **FA1**, add $NH_{3(aq)}$ until in excess.		

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(d)	To a portion of **FA1**, add $BaCl_{2(aq)}$ followed by dilute HC*l*		
(e)	To a portion of **FA1**, add $Pb(NO_3)_{(aq)}$.		
(f)	To a portion of **FA1**, add dilute HC*l* .		
(g)	To a portion of **FA1**, add dilute HNO_3 followed by $AgNO_{3(aq)}$.		

Summary:

cation _____ [1]

anions _____ and _____ [2]

[Total: 20]

QUALITATIVE ANALYSIS NOTES

[Key ppt = precipitate]

1 Reactions of aqueous cations

	reaction with	
	NaOH (aq)	NH_3(aq)
aluminium, Al^{3+}(aq)	white ppt. soluble in excess	white ppt. insoluble in excess
ammonium, NH_4^+(aq)	ammonia produced on heating	
barium, Ba^{2+}(aq)	no ppt. (if reagents are pure)	no ppt.
calcium, Ca^{2+}(aq)	white ppt. with high [Ca^{2+} (aq)]	no ppt.
chromium(III), Cr^{3+}(aq)	grey-green ppt. soluble in excess giving dark green solution	grey-green ppt. insoluble in excess
copper(II), Cu^{2+}(aq)	pale blue ppt. insoluble in excess	blue ppt. soluble in excess giving dark blue solution
iron(II), Fe^{2+}(aq)	green ppt. insoluble in excess	green ppt. insoluble in excess
iron(III), Fe^{3+}(aq)	red-brown ppt. insoluble in excess	red-brown ppt. insoluble in excess
lead(II), Pb^{2+}(aq)	white ppt. soluble in excess	white ppt. insoluble in excess
magnesium, Mg^{2+}(aq)	white ppt. insoluble in excess	white ppt. insoluble in excess
manganese(II), Mn^{2+}(aq)	off-white ppt. insoluble in excess	off-white ppt. insoluble in excess
zinc, Zn^{2+}(aq)	white ppt. soluble in excess	white ppt. soluble in excess

[Lead(II) ions can be distinguished from aluminium ions by the insolubility of lead(II) chloride.]

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